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STREET LIGHT FAULT DETECTION USING RASPBERRY PI

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Abstract: In this paper, street light fault detection is a crucial aspect of smart city infrastructure, ensuring the safety and efficiency of public lighting systems. Traditional methods for fault detection rely on manual inspections or scheduled maintenance, which can be time-consuming, costly, and ineffective. In contrast, modern approaches utilize advanced technologies, such as Internet of Things (IoT) sensors, data analytics, and machine learning, to enable real-time and proactive fault detection. This abstract similar to the principles and applications of intelligent street light fault detection systems.

1.INTRODUCTION

Due to the increase of environmental concern, Street lighting control systems will play an important role in the reduction of energy consumption of the street lighting without impeding comfort goals. As mentioned the energy is the single most important parameter to consider when assessing the impacts of technical systems on the environment. Energy related emissions are responsible for approximately 80% of air emissions and central to the most serious global environmental impacts and hazards, including climate change, acid deposition, smog and particulates.

Street lighting is often the largest electrical load in offices, but the cost of energy consumption is low when compared to the personnel costs. Thus, its energy saving potential is often neglected. According to study global grid-based electricity consumption for street lighting was about 2650 TW in 2017, which was an equivalent of 19% of total global electricity consumption. European office buildings dedicate about 50% of their electricity for street lighting, whereas the share of electricity for street lighting is around 20-30% in hospitals, 15% in factories, 10-15% in schools and 10% in residential buildings.

Intelligent street lighting control and energy management system is a perfect solution for energy saving, especially in public street lighting management. It realizes remote on/off and dimming of lights, which can save energy by 40%, save lights maintenance costs by 50%, and prolong lamp life by 25%. The system application in streetlight control for each lamp will reduce in streetlight electricity and maintenance cost and increase availability of street light.

The system compromises of cloud server, cloud GUI App to display and nodes which are micro controlled and processed with embedded sensors measuring different parameters. Each node in the network is linked to the main server via Wi-Fi protocols. The analog data sensed by the sensor is converted in digital form, processed by microcontroller and then sent to the server.

This scenario increases life of streetlights, reduces power consumption, ease of monitoring and controlling and less installation cost are the various advantages achieved. Due to light emitting diode (LED) with better performances, the demand for developing LED street lighting is growing continuously. Nowadays, a topic of interest in this context is the search for electronic driver in order to take advantage of LED performances.

This work focuses in saving potential pitfalls during intelligent driver design procedure. In this system, we have applied Wi-Fi to intelligent street lighting system. As a result of such a combination one obtains a system designed to increase functionality of light installations for a wide range of applications and introduce a platform for new additional services, which meets current and future user needs. The system is composed of Wi-Fi nodes integrated with light sources based on high power LED diodes.

1.1 Objective

The main objective of this project is street light detection and identification with the help of raspberry pi. Fixing this device in streets automatically detects the street lights fault without manual work.

2. METHODOLOGY

This chapter deals with the design and development overview of the application,a brief description of hardware modules, software tools and its implementation.

The proposed system estimates the to identify the street lights faults of each street by observation which has an improved technique such as a method to obtain an hardware to capture according to its location. We also proposed the approach ofLDR planning based on the result of the detects the lights ON/OFF.

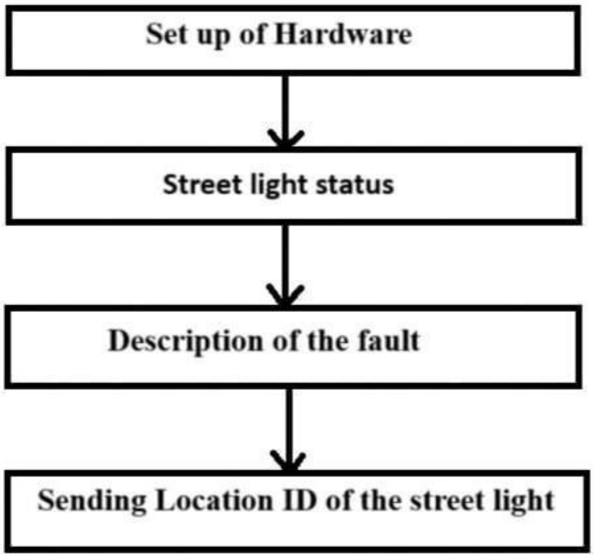

Fig 2.1: Methodology Flow

2.2 Block Diagram

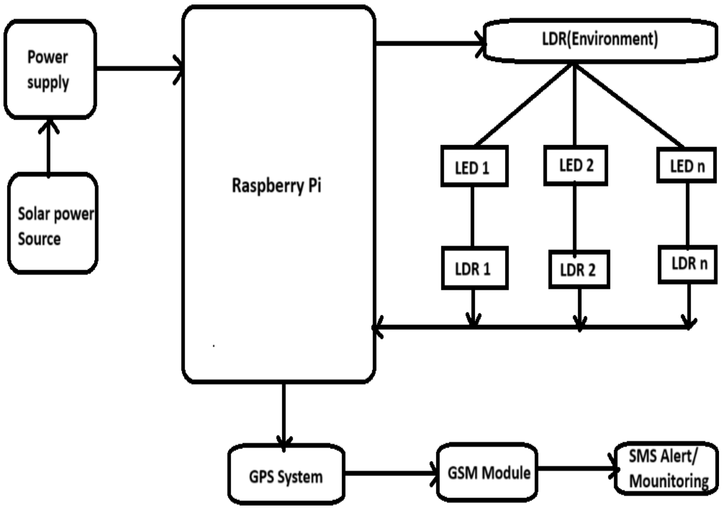

FIG 2.2: BLOCK DIAGRAM OF STREET LIGHT FAULT DETECTION SYSTEM

The block diagram above outlines the communication flow of our proposed system. The power supply is connected to the Raspberry Pi, which serves as the central component of the system. The system is designed to detect faulty street lights, facilitating efficient control by the responsible personnel. Detecting light failures is simplified by sending location information to the system manager. At the core of the operation lies the Light Dependent Resistor (LDR), which captures light rays. When a light goes off, the LDR activates and transmits a response to the Raspberry Pi. Subsequently, the Raspberry Pi relays the location information via the Global Positioning System (GPS) and the Global System for Mobile Communication (GSM). This enables seamless communication and control, ensuring a prompt response to street light faults.

2.4 Flow Chart

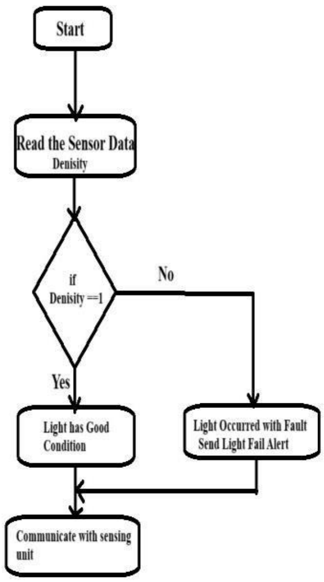

FIG 2.3 FLOW CHART

First, install the hardware on the pole, then proceed to check for faults in the bulb. Once any faults are detected and the light fails, assess the condition of each light, whether it is ON or OFF. Subsequently, transmit the sensor information to the hardware, as illustrated in Figure 2.4. During this process, all sensor data will be sent to the hardware. Utilizing this sensor data, the hardware can generate alert SMS notifications to the respective administrator Additionally, the hardware is equipped to analyze the sensor data comprehensively, ensuring prompt and accurate alert notifications through the GSM module and GPS was used the Location are sent to the administrator.

3. HARDWARE IMPLEMENTATION

3.1 Raspberry pi

Raspberry Pi is a series of small single-board computers developed by the Raspberry Pi Foundation. These affordable, credit-card-sized computers are designed for educational purposes, but they are widely used for various projects and applications. Here are some key points about Raspberry Pi.

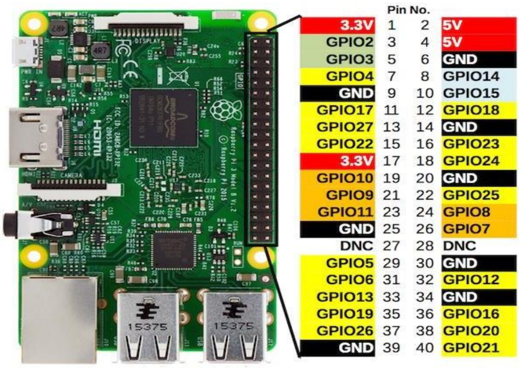

Fig 3.1 Raspberry Pi

3.2 GSM module

GSM stands for global position for mobile communication. GSM is a kind of protocol that is used for mobile or radio communication. It is widely used because it provides low cost, long wireless communication channel where no need of high data rate.

Fig 3.2 GSM(Global System for Mobile Communication) Module

3.3 Fault detection

The faulty condition of the bulbs are detected by using light dependent resistor attached close to the street lights. The LDR offers a high value of resistance thereby making the circuit open. Arm processor will check for this condition only when the corresponding street light is switched ON. When this condition is triggered the arm processor will sends a message to the control room using the GSM modem connected to the processor and thereby making a better management system. The model of fault detection circuit and design is shown in fig 3.3

Fig 3.3 LDR Sensor

3.4 GPS System

A GPS(Global Positioning System)module is a device that communicates with satellites to determine its precise location on Earth. These Modules are commonly used in electronic projects and devices to enable accurate positioning and navigation

Fig 3.4 GPS(Global Positioning System) Module

3.5 Power supply

A power supply is an electrical device that converts electrical energy from one form to another and delivers it to an electrical load. This ensures the load receives the correct voltage, current, and frequency to operate properly.

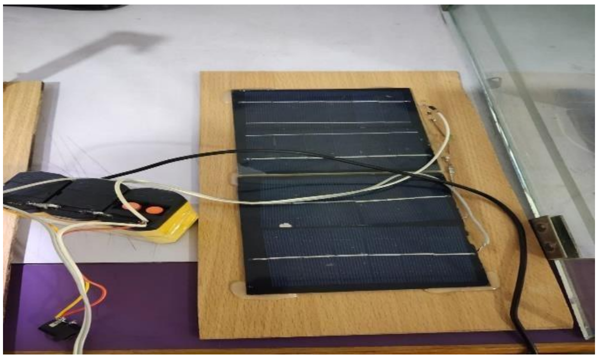

Fig: 3.5 Power Supply(Solar Power)

4. WORKING

In the initial phase, we begin by setting up the Raspberry Pi module with the necessary operating system, as detailed in the Hardware Tools chapter. Once the Raspbian OS is successfully installed, we proceed to incorporate the OpenCV library into the operating system using the commands outlined in the Software Tools chapter. With these foundational steps completed, we transition into the coding phase where we develop the software to operate the street light fault detection prototype in fig 4.

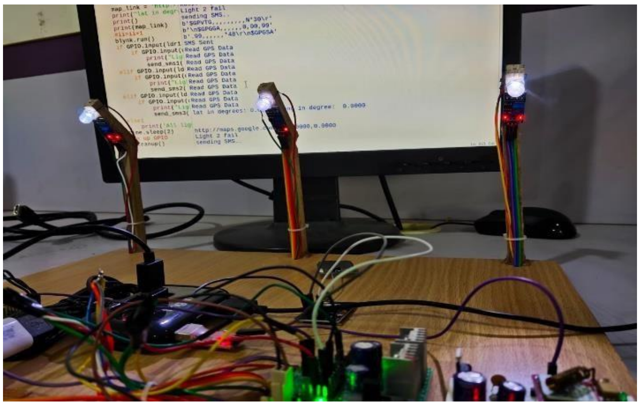

Fig: 4.1 Hardware Kit

5. SOFTWARE IMPLEMENTATION

BLYNK IOT App:

The Blynk app is is really an app editor,Each project can contain graphical widgets, like virtual LEDs, buttons, value displays and even a text terminal, and can interact with one or more devices. With the help of the Blynk library, it is possible to control Arduino or ESP32 pins directly from your phone, without having to write any code at all.

It is also possible to share a project with friends and even customers so that they can access the connected devices but not be able to modify the project. Imagine a scenario where you build a smartphone application where you can control lights, window blinds and room temperature from your phone. You can share the project with other family members so that they can also access the functionality.

With Blynk, you can create smartphone applications that allow you to easily interact with microcontrollers or even full computers such as the Raspberry Pi.

The main focus of the Blynk platform is to make it super-easy to develop the mobile phone application. As you will see in this course, developing a mobile app that can talk to your Arduino is as easy as dragging a widget and configuring a pin. With Blynk, you can control an LED or a motor from your mobile phone with literally zero programming.

This is actually the first experiment that I will demonstrate in this course. But don't let this simplicity make you think that Blynk is only useful for trivial applications. Blynk is a robust and scalable tool that is used by hobbyists and the industry alike. You can use it to monitor the soil humidity of your vegetable garden and turn on the water, or open up your garage door, with your phone.

Blynk. Console is a feature-rich web application catering to different types of users. Its key functionalities include:

1. Configuration of connected devices on the platform, including application settings.
2. Device, data, user, organization, and location management.
3. Remote monitoring and control of device.

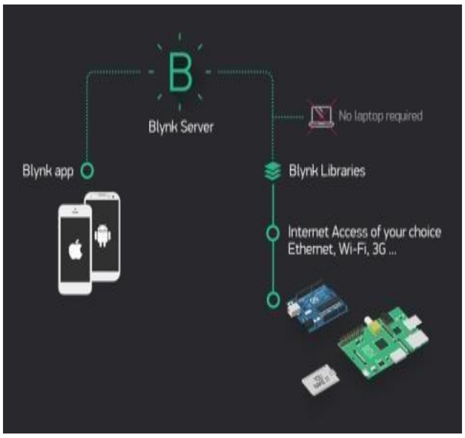

Fig 5.1 Blynk IoT Application

6. CONCLUSION

In conclusion, the proposed real-time street light fault detection system offers a transformative solution to the challenges of maintaining a resilient and efficient urban lighting network. By harnessing the power of intelligent sensors, sophisticated algorithms, and seamless communication, this system illuminates not only our streets but also a path towards a more sustainable and cost-effective future. This conclusion emphasizes the broader impact of the system, highlighting its potential benefits beyond street lighting and connecting it to the larger discussion of sustainability and innovation. It also uses persuasive language and imagery to leave a lasting impression on the reader.

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